# METHOD OF AND APPARATUS FOR THE PREPARATION OF CEMENTITIOUS SLURRIES

Filed Jan. 10, 1939 3 Sheets-Sheet 1

Fig. 1

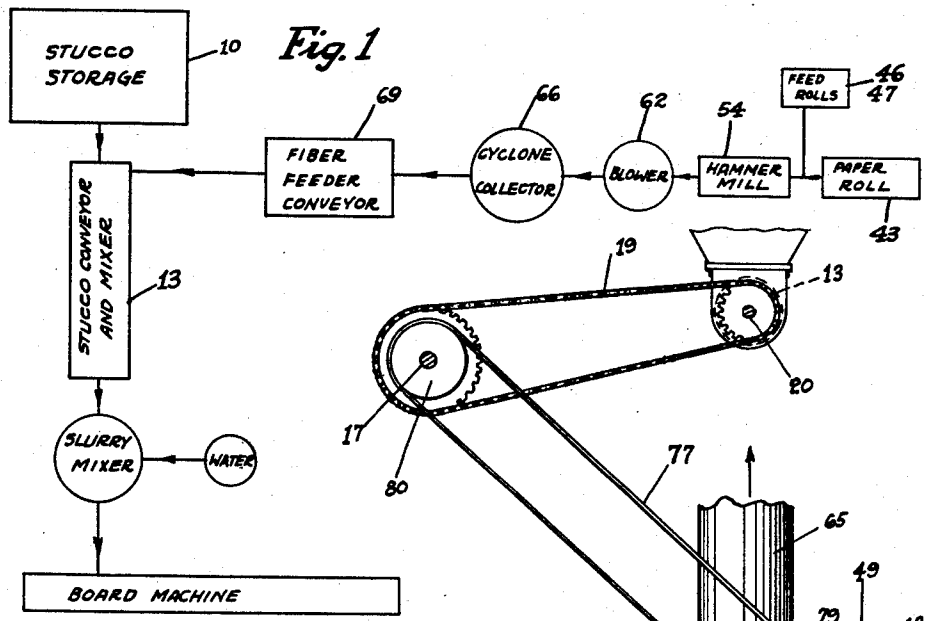



Fig. 6

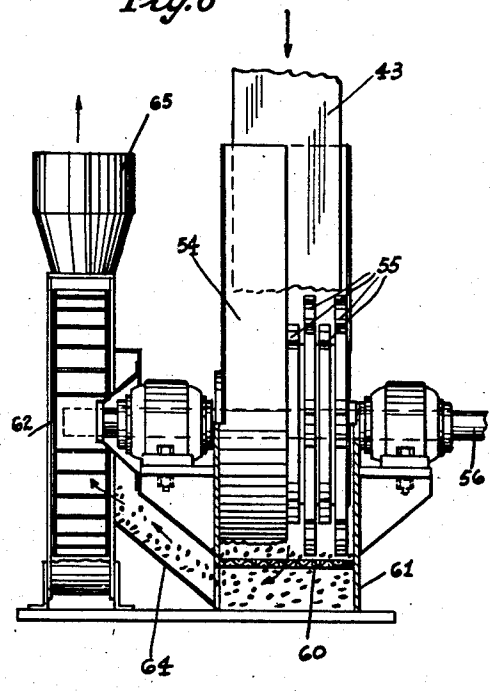
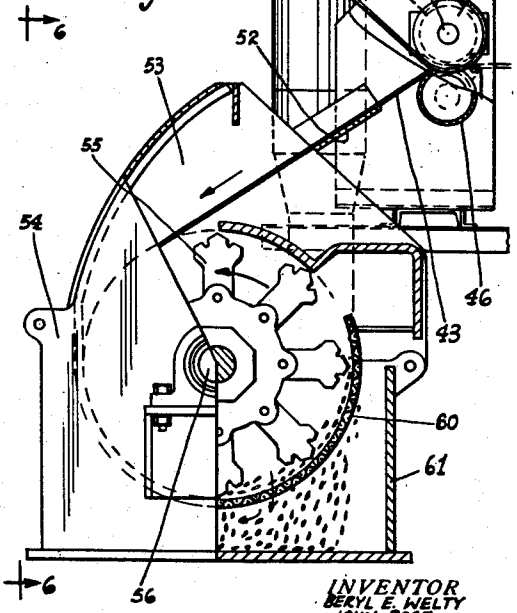



Fig. 5

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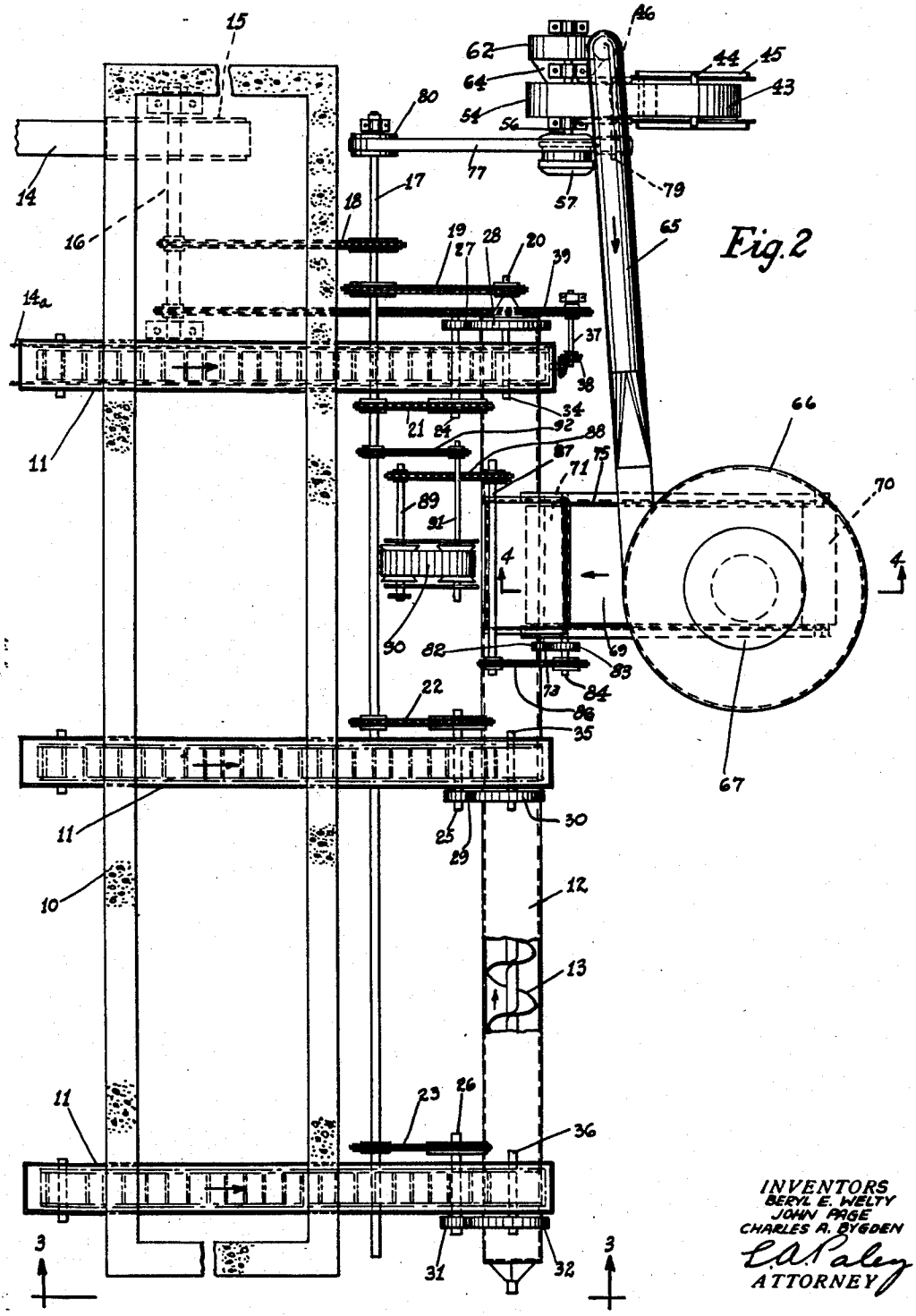


Fig. 2

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Fig. 4

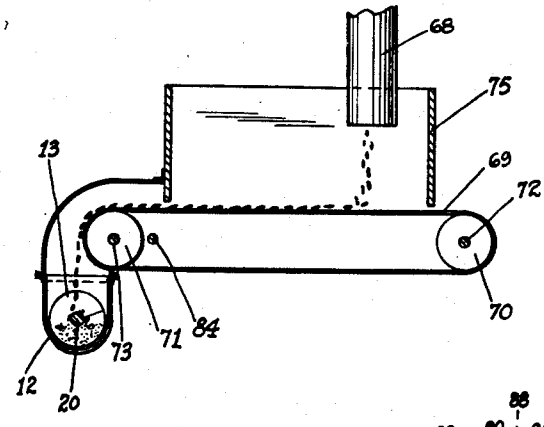


Fig. 3




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# UNITED STATES PATENT OFFICE

2,301,597

## METHOD OF AND APPARATUS FOR THE PREPARATION OF CEMENTITIOUS SLURRIES

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Application January 10, 1939, Serial No. 250,152

6 Claims. (Cl. 83—11)

This invention relates to the manufacture of gypsum boards, blocks or other shapes, and has reference more particularly to the preparation of gypsum slurries containing paper fiber and used in the cores for the boards or for the casting of the blocks.

In the manufacture of gypsum building boards, a core of gypsum composition is enclosed between paper cover sheets. In order to improve the toughness and other characteristics of the gypsum core, it is customary to introduce paper fiber into the core composition at the time of mixing. Considerable difficulty, however, has been experienced in securing a uniform percentage of fiber in the core composition so that the quality of the board varies considerably.

An object of the invention therefore, is to provide a method of introducing paper fiber into the board composition in which the percentage of fiber is maintained substantially uniform.

Another object of the invention is to provide an apparatus suitable for carrying out the above process; also to improve building board making methods and apparatus in other respects hereinafter specified and claimed.

Reference is to be had to the accompanying drawings forming a part of this specification, in which

Fig. 1 is a flow diagram showing the nature of our improved method,

Fig. 2 is a plan view of the apparatus,

Fig. 3 is a sectional elevation through the apparatus,

Fig. 4 is a sectional elevation through the fiber feeding and mixing apparatus, and

Figs. 5 and 6 are sectional elevations through the hammer mill.

It has been proposed to use disintegrated paper fibers mixed with calcined gypsum and other materials to form the core of gypsum building boards. The action of the paper fibers is to toughen the core of the gypsum boards and improve the nailing qualities as well as other improved characteristics in the board. However, disintegrated paper fibers are very difficult to feed uniformly to the stream of calcined gypsum. Disintegrated paper fibers are very susceptible to packing, especially when they are put in a bin so that the density of the material varies greatly in the bin and makes a uniform feed of the fibers substantially impossible thus causing the fiber content of the board to vary considerably. In the production of gypsum building boards, the core is deposited between top and bottom paper cover sheets which are usually trimmed prior to use. A strip of trim paper is thus produced and is wound up into rolls. We have found that this roll of trim paper may be advantageously utilized in the production of paper fiber if the paper from the roll is fed continuously into a hammer mill which acts on the end of the strip of paper to produce paper fibers. These paper fibers may then be separated from air and continuously delivered by a conveyor belt into a stream of calcined gypsum going to the board machine. The amount of gypsum-fiber in the board core may be maintained substantially uniform within very close limits since speed of feeding of the trim paper into the hammer mill can be in direct proportion to the speed of the feed of the calcined gypsum leading to the board machine.

In order to more fully explain the general arrangement of the method and apparatus, we have illustrated a flow diagram in Fig. 1 showing the various steps in producing the gypsum building board. The paper trim unwinding from a roll passes between feed rolls which are driven in direct relation to the speed of feed of the stucco or calcined gypsum to the board machine. These feed rolls introduce the end of the paper trim strip into a hammer mill which disintegrates the paper trim into fine paper fibers. A mixture of air and paper fibers are picked up by a blower and delivered to a cyclone collector for the paper fibers, the latter dropping onto a fiber feeder conveyor which conveys the paper fibers directly to a screw conveyor mixer where the paper fibers are thoroughly incorporated with the stream of calcined gypsum. The mixture of calcined gypsum and paper fibers is then delivered to a slurry mixer where water is incorporated with the mass, and the resulting slurry is deposited between the paper cover sheets on the standard board machine which is well known in the art. Describing the apparatus more in detail, a stucco or calcined gypsum storage bin 10 is preferably in elongated form and has a plurality of drag chain conveyors 11 passing through the bottom of said bin to continuously withdraw the calcined gypsum therefrom. These conveyors 11 deliver the calcined gypsum into the housing 12 of a screw conveyor 13 which serves to also mix the paper fiber with the stucco as it is conveyed. A screw conveyor $14_a$ leads from the end of conveyor 13 to the slurry mixer for producing slurry for the board machine.

A variety of driving devices might be used in causing the movement of the various components of the apparatus but for the purpose of illustration, we show a driving belt 14 leading

from a source of power not shown, such as a motor or steam engine. This belt 14 passes about a pulley 15 which is mounted upon a drive shaft 16. A countershaft 17 is connected by a chain 18 to the power shaft 16 and a chain 19 connects the countershaft 17 to a screw conveyor shaft 20. Chains 21, 22 and 23 connect the countershaft 17 with countershafts 24, 25 and 26, respectively. Spur gears 27, 28, 29, 30, 31 and 32 connect the shafts 24, 25 and 26 with shafts 34, 35 and 36, respectively, the latter three shafts operating the drag chain conveyors 11. The screw conveyor $14_a$ is driven by a countershaft 37 through bevel gears 38 from the chain 39 connecting the countershaft 37 to the shaft 16.

The salient feature of our invention is composed of a combination of a roll of trim paper 43 which is rotatably mounted on a shaft 44 supported on a frame 45. The paper 43 passes between feed rolls 46 and 47, the latter roll being rotatably supported on suitable take-up bearings 48 adjusted by screw 49 so as to regulate the pressure of the rolls 46 and 47 on the strip of trim paper. After leaving the rolls 46 and 47 the paper 43 passes downwardly over a guide table 52 into the throat 53 of a hammer mill 54. Rotating hammers 55 in the hammer mill 54 are mounted upon a shaft 56 which is rotated by a motor 57. The strip of paper is disintegrated by the rapidly rotating hammers 55 and passes through a peripheral screen 60 into the housing 61 of the hammer mill. A blower 62 driven by shaft 56 picks up the fibers which pass through screen 60 and sucks them through a duct 64 into the blower 62 and then elevates the mixture of air and fibers through duct 65 into a cyclone separator 66. In the separator 66, the air separates from the fibers and passes upwardly through a central vent 67 and the fibers fall downwardly through a duct 68 onto a conveyor belt 69 which passes around pulleys 70 and 71. Shafts 72 and 73 rotatably support the pulleys 70 and 71, respectively, below a hopper 75 into which the fibers fall from duct 65. The fibers from a conveyor belt 69 are delivered into the screw conveyor housing 12 to be mixed with the stream of calcined gypsum or stucco which is continuously advanced by screw conveyor 13 toward the mixer for the board machine. In this mixer, water is introduced into the mixture of stucco and fibers to form a slurry and this slurry is delivered between the paper cover sheets to form a building board, in the manner well known to the art.

One of the important features of the invention is that the feed rolls 46 and 47 are driven at a speed in direct relation to the speed of the screw conveyor 13 by means of a belt 77 which passes around a pulley 78 which is secured to a shaft 79 on which the roll 47 is mounted. The belt 77 also passes around a pulley 80 secured to the countershaft 17. The conveyor shaft 73 supporting the fiber delivery conveyor 69 is driven through spur gears 82 and 83, said gear 83 being secured to a countershaft 84. A chain 86 connects the shaft 84 with a countershaft 87 and a chain 88 connects the shaft 87 with a shaft 89. A variable speed transmission 90 of standard design connects the shaft 89 with a countershaft 91 and a chain 92 connects the shaft 91 with the countershaft 17. Thus it will be seen that the paper feed rolls 46 and 47 start and stop simultaneously with the movements of the screw conveyor 13 and the same applies to the fiber delivery belt 69. The speed of the feed rolls 46 and 47 is adjusted by the proper proportioning of the pulleys 79 and 80 and the speed of the delivery belt 69 is regulated by the variable speed transmission 90. By the mechanism described, the percentage of paper fibers introduced into the board core is maintained very uniform within a fraction of 1% variation, whereas in older and less perfect methods of feeding the fiber the percentage of fiber in the core could easily vary by 10% within a space of a very few minutes.

In operation, the trim strip paper 43 in roll form unwinds and is advanced forwardly by means of feed rolls 46 and 47 into the hammer mill housing 53 where it is disintegrated by hammers 55 into paper fibers which pass through screen 60. These paper fibers are picked up by blower 62 and elevated through duct 65 into cyclone separator 66 which separates the air from the fibers. The fibers fall down upon belt conveyor 69 and are delivered into the screw conveyor housing 13 to be mixed with the advancing stream of calcined gypsum leading to the board plant mixer. Suitable drives are provided for the feed rolls 46 and 47 and for the hammer mill 54 and blower 62 so as to insure a substantially uniform percentage of fiber in the board core at all times.

We would state in conclusion that while the illustrated example constitutes an embodiment of our invention, we do not wish to limit ourselves precisely to these details since manifestly the same may be considerably varied without departing from the spirit of the invention as defined in the appended claims.

Having thus described our invention, we claim as new and desire to secure by Letters Patent:

1. An apparatus for continuously mixing a cementitious material and a loose aggregate of paper fibers which comprises a storage means for said cementitious material, a screw conveyor means for removing said cementitious material from said storage means at a constant, predetermined rate, a means for supporting a roll of paper, a hammer mill for disintegrating a strip of paper from said roll to the fibrous condition, means for feeding said strip into said hammer mill, pneumatic means for conveying the fiberized product from said hammer mill as rapidly as it is produced to a cyclone separator, means for continuously discharging the fibers from the separator into said screw conveyor means wherein said fibers and said cementitious material are commingled and thoroughly intermixed, and means operative between said screw conveyor means and said strip feeding means whereby the proportion of fibers introduced into the cementitious material in the screw conveyor may be predetermined.

2. An apparatus for the continuous production of a cementitious slurry having uniform proportions of paper fibers incorporated therewith which comprises a storage means for dry powdered cementitious material, a conveyor means for transporting a continuous stream of said dry cementitious material from said storage means, a means for supporting a strip of paper, means for comminuting said strip to the dry fibrous state, feeding means for introducing said strip into said comminuting means at a predetermined rate, means for conveying the dry fibers as they are produced in a continuous stream from said comminuting means, means for commingling and intermixing the two said dry streams thus produced at the rate they are formed, means operative between said cementitious conveyor means and said strip feeding means whereby

the proportion of fibers continuously mixed with the stream of cementitious material in the conveyor may be regulated, and means for incorporating water with the resulting mixture to form the desired slurry.

3. In an apparatus for continuously producing a cementitious slurry having loose paper fibers incorporated therewith, storage means for substantially dry, powdered, cementitious material, a screw conveyor means associated with said storage means for continuously and uniformly advancing a body of said cementitious material from said storage means, a means for supporting a roll of paper, a hammer mill associated with said roll for comminuting a strip of paper from said roll to the fibrous condition, feeding means for continuously advancing said strip to said mill, control means for regulating said feeding means in accordance with the rate at which said screw conveyor means advances said cementitious material, a cyclone separator, pneumatic means for removing the fibers from said hammer mill as rapidly as produced to said cyclone separator, means for removing the fibers from said separator in a continuous uniform stream, means for introducing said fibers into said screw conveyor whereby said fibers become thoroughly and uniformly mixed with said advancing body of cementitious material, and means for mixing water with said mixture to form a slurry.

4. An apparatus for continuously mixing a substantially dry cementitious material and a loose aggregate of substantially dry paper fibers which comprises a storage means for said cementitious material, a conveyor means for removing said cementitious material from said storage means at a constant, predetermined rate, means for comminuting a substantially dry strip of paper to a dry fibrous condition, means for feeding said strip of paper to said comminuting means, means for continuously discharging the resulting substantially dry paper fibers from said comminuting means to said conveyor means as rapidly as they are formed, means for thoroughly mixing said fibers and cementitious material in the substantially dry state, and means operative between said strip feeding means and said conveyor means for proportioning the amounts of paper fibers and cementitious material in accordance with a predetermined value.

5. The continuous method of incorporating substantially dry, loose paper fibers with a substantially dry, powdered cementitious material which comprises continuously advancing a stream of said cementitious material, separately and continuously advancing a strip of paper to a comminuting zone at a rate proportioned to the rate of advancement of said stream of cementitious material, passing said strip of paper through said comminuting zone whereby said paper is fiberized, removing the resulting paper fibers from said comminuting zone as rapidly as they are produced in a continuous stream, introducing said stream of paper fibers as soon as formed into said stream of cementitious material, the relative amounts of cementitious material and fibers in the resulting mass being predetermined by the relative proportional rates of advancement of said stream of cementitious material and said strip of paper, and thoroughly mixing the fibers and cementitious material in the dry condition.

6. The continuous method of incorporating substantially dry, loose paper fibers with a substantially dry, powdered cementitious material which comprises continuously advancing a stream of said cementitious material through a dry mixing zone, separately and continuously advancing a strip of paper to a comminuting zone at a rate proportioned to the rate of advancement of said stream of cementitious material, passing said strip of paper through said comminuting zone whereby said paper is fiberized, pneumatically removing the resulting paper fibers from said comminuting zone as rapidly as they are produced in a continuous stream, introducing said stream of paper fibers into said mixing zone at the rate they are formed wherein said paper fibers and said cementitious material are thoroughly mixed in the dry condition, the relative amounts of each being predetermined by the relative proportional rates of advancement of said stream of cementitious material and said strip of paper.

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